(a) Draw the project network and identify all the paths through it.

(b) Determine the expected project length.

(c) Calculate the standard deviation and variance of the project length.

(d) What is the probability that the project will be completed?

  (i) at least 4 weeks later than excepted time?

  (ii) no more than 4 weeks later than expected time?

20. Chhabra Saree Emporium has a single cashier. During the rush hours, customers arrive at the rate of 10 per hour. The average number of customers that can be processed by the cashier is 12 per hour. On the basis of this information. find the following :

- Probability that the cashier is idle
- Average number of customers in the queuing system
- Average time a customer spends in the system
- Average number of customers in the queue
- Average time a customer spends in the queue.

NOVEMBER/DECEMBER 2023

GECA24A/ DECA24A — OPERATIONS RESEARCH

Time : Three hours Maximum : 75 marks

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SECTION A — (10 × 2 = 20 marks)

Answer ALL the questions.

1. What is meant by LPP?

2. Define Optimal solution.

3. Define degeneracy.

4. What is the Assignment problem?

5. Define pure integer program.

6. How to solves integer programs by cutting-plane algorithm?

7. What is PERT and CPM?

8. Define pessimistic time.

9. What is meant by system capacity?

10. Give the arrival types.

SECTION B — ($5 \times 5 = 25$ marks)

Answer ALL the questions.

11. (a) Solve the following using LPP.

A person wants to decide the constituents of a diet which will fulfil his daily requirements of proteins, carbohydrates at the minimum cost. The choice is to be made from four different types of foods. The yield per unit of these foods are given in the following table :

Food type	Proteins	Fats	Carbohydrates	Cost per unit (Rs.)
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Minimum Requirement	800	200	700	

Formulate a linear programming model for the problem.

Or

17. Determine an initial basic feasible solution to the following transportation problem using North West corner rule.

	D_1	D_2	D_3	D_4	Availability
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
Requirement	6	10	15	4	35

Here O_i and D_j represent i^{th} origin and j^{th} destination.

18. Solve the following integer programming problem using Gomory's Cutting plane method, Max $Z = 5x_1 + 7x_2$, subject to conditions $-2x_1 + 3x_2 \leq 6$, $6x_1 + x_2 \leq 30$ and $x_1, x_2 \geq 0$ and integer.

19. A small project is composed of seven activities whose time estimates are listed in the following table :

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Activity	t_o	t_m	t_p
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

15. (a) A Television repairman finds that the time spent on his jobs has an exponential distribution with mean 30 minutes. If he repairs the sets in the order in which they come in and if the arrivals of sets are approximately Poisson with an average rate of 10 per 8 hours day which is the repairs man idle time each day? Find the expected number of units in the system and in the queue?

Or

(b) What do you understand by a queue? Give some important applications of queuing theory.

SECTION C — $(3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Solve this problem graphically.

Maximize $z = 4x_1 + 12x_2$,

Subject to

$3x_1 + x_2 \leq 180$

$x_1 + 2x_2 \leq 100$

$-2x_1 + 2x_2 \leq 40$

$x_1 \geq 0, x_2 \geq 0$

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(b) Find the optimum solution for the following problem :

Maximize : $p = 4x + 5y + 6z$

Which is subject to three constraints :

Subject to

$$\begin{cases} 2x + 3y + z \leq 900 \\ 3x + y + z \leq 350 \\ 4x + 2y + z \leq 400 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

12. (a) Solve the problem using Hungarian assignment method. A plant manager has four subordinates and four tasks to be performed. The subordinates differ in efficiency and the tasks differ in their intrinsic difficulty. This estimate of the times each man would take a perform each task is given in the effectiveness matrix below :

	I	II	III	IV
A	8	26	17	11
B	13	28	4	26
C	38	19	18	15
D	19	26	24	10

How should the tasks be allocated, one to a man, so as to minimize the total man hours?

Or

(b) A computer centre has got three expert programmers. The centre needs three application programmes to be developed. The head of the computer centre, after studying carefully the programmes to be developed, estimates the computer time in minutes required by the experts to the application programme as follows :

		Programmers		
		P	Q	R
	1	120	100	80
Programmers	2	80	90	110
	3	110	140	120

Assign the parameters to the programme in such a way that the total computer time is least.

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13. (a) Determine $z^* = \max z = 5x_1 + 8x_2$

Subject to the constraints

$x_1 + x_2 \leq 6,$

$5x_1 + 9x_2 \leq 45,$

$x_1, x_2 \geq 0$ and integer.

Or

(b) Solve the mixed-integer programming knapsack problem :

Maximize $z = 6x_1 + 4x_2 + 4x_3 + x_4 + x_5$

Subject to :

$2x_1 + 2x_2 + 3x_3 + x_4 + 2x_5 = 7$

$x_1 \geq 0 \ (j = 1, 2, ...5)$

x_1 and x_2 integer.

14. (a) A project has the following times schedule

Activity	Times in weeks	Activity	Times in weeks
(1-2)	4	(5-7)	8
(1-3)	1	(6-8)	1
(2-4)	1	(7-8)	2
(3-4)	1	(8-9)	1
(3-5)	6	(8-10)	8
(4-9)	5	(9-10)	7
(5-6)	4		

Construct the network and compute :

(i) T_E and T_L for each event

(ii) Float for each activity

(iii) Critical path and its duration.

Or

(b) Draw the network for the following activities and find critical path and total duration of project :

Activity	Duration (months)	Activity	Duration (months)
1-2	2.5	4-5	2.0
2-3	2.5	5-6	3.0
2-4	1.5	6-7	1.5
3-4	1.0	5-7	1.5
3-5	10		